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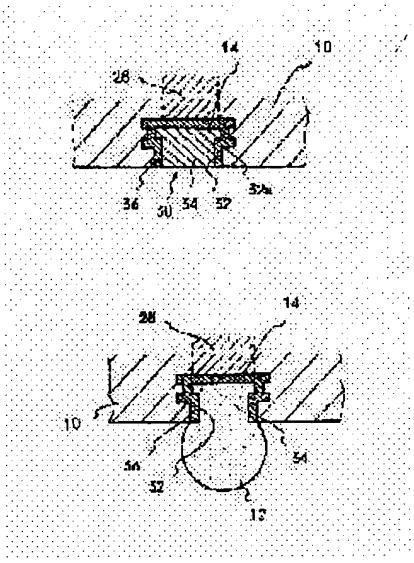
(54) SEMICONDUCTOR PACKAGE AND SEMICONDUCTOR DEVICE USING THE SEMICONDUCTOR PACKAGE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a semiconductor device with high reliability by preventing breakage or the like at a junction portion of an external connection terminal due to a thermal stress caused by the difference between a thermal expansion coefficient of a package substrate and that of the semiconductor package when packaging the semiconductor device.
SOLUTION: A semiconductor package is formed by connecting an external connection terminal 12 to a terminal pad 14 for external connection which is formed on a packaging surface of a ceramic circuit board 10. In the semiconductor package, the terminal pad 14 is exposed on the inner bottom surface a portion where the terminal pad is formed. A step portion is formed in an inner wall of the circuit board 10, whereby the diameter of an opening on the terminal pad 14 side is larger than that of an opening on the side to be connected to the external connection terminal 12. Further, an external connection-terminal joint portion 30 is formed by filling low-melting point metal 34 in a cavity 32 where a metal layer 36 is formed on the surface of the inner wall.



LEGAL STATUS

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* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the semiconductor device using the semiconductor package and this which use terminals, such as a solder ball, as an external end-connection child.
[0002]
[Description of the Prior Art] With the product which attached the ball-like terminal as an external end-connection child like a BGA (Ball Grid Array) type semiconductor device, when a semiconductor device is mounted, it has been a problem that thermal stress acts on an external end-connection child according to the difference of the coefficient of thermal expansion of a mounting substrate and a semiconductor package, and an external end-connection child may be damaged. Although the semiconductor package which makes especially a ceramic substrate the circuit board has the advantage that high-density wiring is possible and a semiconductor device with big calorific value can be carried, it has the problem that the operation of thermal stress which mentioned above the printed-circuit board (resin substrate) etc. from the difference of the coefficient of thermal expansion of the mounting substrate and the ceramic substrate of a semiconductor package which are mainly used being large becomes large.
[0003] Drawing 10 shows the composition of the portion which joined the solder ball to the substrate as an external end-connection child 12 by the semiconductor package which used the ceramic circuit board 10. 14 is connected with the internal circuit pattern in a substrate with the terminal pad formed in the ceramic circuit board 10, and the solder ball is joined to the terminal pad 14 through the low melting point solder 16. Thus, although the method of joining the external end-connection child 12 to a terminal pad 14 directly is common practice as the external end-connection child's 12 mounting arrangement, it acts on the part to which the thermal stress which originates in the difference of the coefficient of thermal expansion of the ceramic circuit board 10 and a mounting substrate in this case has joined the external end-connection child 12 with the low melting point solder 16, and the phenomenon in which a crack occurs at this joint grade arises.
[0004] As a method of preventing the problem which the external end-connection child's 12 soldered joint section damages with thermal stress, as shown in drawing 11 , there is a method which establishes a crevice 20 in the component side of the ceramic circuit board 10, is filled up with solder in this crevice 20, and forms the soldered joint section (external end-connection child joint) 18. A terminal pad 14 is arranged in the inner base of a crevice 20, and a terminal pad 14 and the external end-connection child 12 flow electrically by being filled up with solder in a crevice 20. The external end-connection child 12 is attached through the soldered joint section 18.
[0005] Thus, when based on the composition which connects the external end-connection child 12 through the ******** joint 18 which filled up with and formed solder in the crevice 20 A weak joint is reinforced and held by the ceramic circuit board 10 at distortion, Since the adhesion area of the soldered joint section 18 and the ceramic circuit board 10 can become large and the bonding strength of a joint can be raised, a joint can be made hard to damage by operation of thermal stress, and it becomes possible to raise the endurance of a joint.
[0006]
[Problem(s) to be Solved by the Invention] The method of joining the external end-connection child 12 through the soldered joint section 18 as mentioned above prevents breakage by reinforcing a part for the joint which is easy to damage by operation of thermal stress. However, when it is said that a substrate large-sized as a package substrate is used, the reliability of an external end-connection child's joint becomes still more important, and sufficient reliability which the amount of [of an external end-connection child] connection does not damage by the thermal fatigue is searched for.
[0007] This inventions are the semiconductor package of the surface mount type which uses external end-connection children, such as the above solder balls, and a semiconductor device using this, even when thermal stress acts on an external end-connection child's joint, a joint can be held certainly, without producing the problem of breakage and ablation of a joint, and it aims at enabling it to provide as a reliable product by this.
[0008]
[Means for Solving the Problem] this invention is equipped with the next composition in order to attain the above-mentioned purpose. Namely, it sets to the semiconductor package which joins an external end-connection child to the terminal pad for external connection formed in the component side of the ceramic circuit board, and grows into it. The aforementioned terminal pad is exposed to the part in which the aforementioned terminal pad was formed on an inner base. While the level difference section which is that the diameter of is expanded rather than the diameter of opening of the side to which the diameter of opening by the side of this terminal pad joins the aforementioned external end-connection child is formed in an internal surface, it is

characterized by forming the external end-connection child joint which it fills up with a low melting point metal, and changes in the crevice where the metal layer was formed in this internal surface. Moreover, that by which the aforementioned level difference section was formed in multi-stage, the thing by which the metal layer was formed in the level difference side of the aforementioned level difference section, That in which the level difference side for the aforementioned metal layer joining the aforementioned external end-connection child to the opening edge of the aforementioned crevice on the thing and the aforementioned opening edge by which covering formation was carried out was formed, What nickel plating and gilding were given for the aforementioned metal layer on the surface of the metallized layer is effective when raising the endurance of an external end-connection child's joint, and reliability. Moreover, it is characterized by carrying a semiconductor device in the aforementioned semiconductor package, joining an external end-connection child to the aforementioned external end-connection child joint as a semiconductor device, and changing, and it fills up with solder in a crevice as the aforementioned low melting point metal, and is characterized by joining a solder ball as an external end-connection child.

[0009]

[Embodiments of the Invention] Hereafter, based on an accompanying drawing, it explains per suitable operation gestalt of this invention. Drawing 1 is the cross section of 1 operation gestalt of the semiconductor package concerning this invention. The semiconductor package of this operation gestalt forms the external end-connection child joint 30 for joining the external end-connection child 12 to the component side of the ceramic circuit board 10 which makes an alumina, alumimium nitride, etc. a principal component according to the arrangement position of a terminal pad 14. The external end-connection child joint 30 forms the crevice 32 where even a terminal pad 14 leads from the component side of the ceramic circuit board 10, and fills up with and forms solder 34 in a crevice 32.

[0010] The external end-connection child joint 30 is expanded and shown in drawing 2 . In a flat-surface configuration, opening of the crevice 32 filled up with solder 34 is carried out circularly, it is prepared, and it considers as the two-step composition from which a path size differs in the depth direction, and is characterized by to make the diameter of the path size by the side of opening of the outside of level difference section 32a reduce rather than an inside path size, and to prepare it, and having covered the internal surface of a crevice 32 with the metal layer 36, and metalizing it.

[0011] By the component side of the ceramic circuit board 10, the external end-connection child joint 30 which fills up solder 34 with this operation gestalt in a crevice 32 by having prepared the level difference in the internal surface of a crevice 32, and having formed the level difference side in the internal surface, forms, and changes falls out and stops, and is carried out, and it becomes possible to support the external end-connection child joint 30 certainly to the ceramic circuit board 10 by this. Moreover, by having covered the internal surface of a crevice 32 with the metal layer 36, the wettability of the internal surface of a crevice 32 and solder 34 improves, solder 34 sticks to the inside of a crevice 32 certainly, and the external end-connection child joint 30 is certainly held by this at the ceramic circuit board 10. Furthermore, when the adhesion area of solder 34 and the internal surface of a crevice 32 increases, the external end-connection child joint 30 comes to be certainly supported by the ceramic circuit board 10.

[0012] In addition, as for the bonding area of a circuit pattern, and 26, the cavity for 22 carrying a semiconductor device by drawing 1 and 24 are [an internal circuit pattern and 28] beer. A semiconductor device and a terminal pad 14 are electrically connected through a bonding area 24, the internal circuit pattern 26, and beer 28.

[0013] Drawing 3 is the cross section of the semiconductor device which carried the semiconductor device 40 in the above-mentioned semiconductor package. After the semiconductor device of this operation gestalt carries out die attachment of the semiconductor device 40, connects a semiconductor device 40 and a bonding area 24 to the base of a cavity 22 by wirebonding and closes a semiconductor device 40 with a cap 42, it joins a solder ball to the external end-connection child joint 30 as an external end-connection child 12, and grows into it.

[0014] Drawing 4 expands and shows the state where the solder ball was joined to the external end-connection child joint 30 as an external end-connection child 12. A solder ball fuses the solder 34 with which the crevice 32 of the external end-connection child joint 30 was filled up, and is joined to solder 34 by one. As mentioned above, a solder ball is supported by the ceramic circuit board 10 very firmly through solder 34 being formed in the level difference side of a configuration that the internal surface of a crevice 32 should stop falling out, and by having metalized the internal surface of a crevice 32.

[0015] The manufacture method of the semiconductor package which has the above-mentioned external end-connection child joint 30 in drawing 5 and 6 is shown. The semiconductor package of this operation gestalt is characterized by in addition to the ceramic green sheet which constitutes the main part of a semiconductor package, carrying out the laminating of the ceramic green sheet for forming the external end-connection child joint 30, and really forming it.

[0016] Drawing 5 shows the ceramic green sheet which carries out a laminating, in order to form a semiconductor package. 50a, 50b, and 50c are ceramic green sheets which constitute this soma of a semiconductor package. 52 is the metallizing pattern formed by the predetermined pattern using the tungsten **-strike or the molybdenum **-strike in order to form a bonding area 24 and the internal circuit pattern 28. 54 is the metallizing paste with which formed the beer hall in the ceramic green sheets 50b and 50c in order to form beer 28, and the beer hall was filled up. 56 is the metallizing **-strike put on the inferior surface of tongue of ceramic green-sheet 50c according to the pattern of a terminal pad 14. Operation of restoration of these metallizing pattern 52 and the metallizing **-strike 54 to a beer hall etc. is completely the same as that of the manufacture method of the usual multilayer ceramic package.

[0017] 60a and 60b are ceramic green sheets used in order to form the external end-connection child joint 30 in a package substrate. As mentioned above, since the internal surface of the crevice 32 of the external end-connection child joint 30 is formed in the shape of a level difference, it forms this level difference configuration by the ceramic green sheets 60a and 60b of two

sheets. The process of the ceramic green sheets 60a and 60b is shown in drawing 6 . The ceramic green sheets 60a and 60b use a thing with a thickness of about 0.5mm. Drawing 6 (a) The state where Bores 62a and 62b were first formed according to the arrangement position of a terminal pad 14 by punching is shown. In order to consider as a configuration stop escaping from a crevice 32, the diameter of opening of bore 62b is set up smaller than the path size of bore 62a.

[0018] Next, in order to metalize the internal surface of Bores 62a and 62b, the internal surface of Bores 62a and 62b is coated with the metallizing **-strike 64. It is good for this coating to use the metallizing paste of hypoviscosity. Subsequently, the part which counters the opening edge of ceramic green-sheet 60a is coated with the metallizing **-strike 64 on the opening edge of bore 62b formed in ceramic green-sheet 60b (drawing 6 (b)). This metallizing **-strike 64 needs to be coating operated in order to also metalize the portion of the level difference side formed in the internal surface of a crevice 32.

[0019] Drawing 6 (c) It is in the state which carried out alignment of the ceramic green sheets 60a and 60b, and piled them up. The crevice 32 which has the level difference of a configuration stop escaping as shown in drawing is formed as mentioned above by making the diameter of opening of Bores 62a and 62b into a different diameter.

[0020] Alignment of the above-mentioned ceramic green sheets 60a and 60b and the ceramic green sheets 50a, 50b, and 50c mentioned above is carried out, the ceramic circuit board 10 carries out a laminating, after it heats and pressurizes and unifies, is calcinated at predetermined temperature and obtained as a sintered compact. In this way, nickel plating as for example, ground plating and protection plating by gilding are performed to the part which metallizing patterns including the terminal pad 14 of the obtained ceramic circuit board 10 expose. Thereby, the metallizing section of the ceramic circuit board 10 is covered with protection plating, and a bonding area 24, a terminal pad 14, and the metal layer 36 of the internal surface of a crevice 32 are formed.

[0021] In order to fill up a crevice 32 with solder 34, it is because turn a crevice 32 upward, the ceramic circuit board 10 is supported, the ceramic circuit board 10 is heated in the state where the solder tablet has been arranged to the crevice 32 and a solder tablet is fused. The solder which this fused fills a crevice 32 and the external end-connection child joint 30 with which solder 34 was filled up into the crevice 32 is obtained. What is necessary is just to set up a solder tablet by the quantity which fills a crevice 32. In this way, it flows electrically with a terminal pad 14, and the semiconductor package which has the external end-connection child joint 30 formed in the configuration stop escaping is obtained.

[0022] In addition, although there may also be the method of making the internal surface of a crevice 32 a back taper side among the methods of making it into a configuration stop escaping from a crevice 32, a manufacturing process becomes complicated and is not practical [preparing the breakthrough which makes an internal surface a back taper side in a ceramic green sheet]. On the other hand, in the case of the above-mentioned manufacture method, since what is necessary is just to form Bores 62a and 62b at right angles to the flat surface of the ceramic green sheets 60a and 60b, there is an advantage that manufacture is easy.

[0023] Drawing 7 shows other operation gestalten of the external end-connection child joint 30 formed in a semiconductor package. In case this operation gestalt joins the external end-connection children 12, such as a solder ball, to the external end-connection child joint 30, in order that it may raise the external end-connection child's 12 junction nature, it is characterized by preparing metal layer 36a along the opening edge of the side which joins the external terminal of a crevice 32. Metal layer 36a is drawing 6 (b). In case ceramic green-sheet 60b is coated with the metallizing **-strike 64 so that it may be shown, it can form by coating the opening edge of another side of bore 62b.

[0024] By preparing metal layer 36a in the opening edge of a crevice 32, the wettability at the time of joining the external end-connection child 12 is raised, and it makes it possible to join the external end-connection child 12 certainly. The problem that the external end-connection child's 12 external end-connection child joint is damaged with the thermal stress at the time of mounting by this can be prevented.

[0025] Drawing 8 shows the example of composition of further others of the joint which joined the external end-connection child 12 to the external end-connection child joint 30. With this operation gestalt, the level difference side 37 is established in opening of the side which joins the external end-connection child 12 of a crevice 32, and it is characterized by metalizing the level difference side 37 and the whole internal surface of a crevice 32. It becomes possible to raise the bonding strength of the external end-connection child 12 in a joint, and to raise the endurance of a joint by having established the level difference side 37 which put the metal layer 36. When forming the level difference side 37 for joining the external end-connection child 12 like this operation gestalt, three external end-connection child joints 30 are formed using a ceramic green sheet.

[0026] Drawing 9 shows the example of composition of further others which joined the external end-connection child 12 to the external end-connection child joint 30. The external end-connection child joint 30 of this operation gestalt is characterized by forming the level difference side for considering as a configuration stop escaping from a joint in two steps. That is, it forms by making into a three-sheet pile the ceramic green sheet which constitutes the external end-connection child joint 30 from this operation gestalt, setting up so that the path size of the bore by the side of opening which joins the external end-connection child 12 may become small gradually, and carrying out a laminating to one. It becomes possible to escape from the external end-connection child joint 30 still more certainly, to stop it, and to carry out it by forming a level difference side in multi-stage like this operation gestalt.

[0027] In addition, although solder 34 was filled up with each above-mentioned operation form into the crevice 32 which constitutes the external end-connection child joint 30, if it is the low melting point metal whose junction of not only solder but the external end-connection child 12 is enabled, it can be suitably used for a crevice 32. Moreover, the external end-connection child 12 can also use not only a solder ball but the terminal of the shape of a ball which put solder on the front face of **** etc.

[0028]

[Effect of the Invention] As the semiconductor device using the semiconductor package and this concerning this invention was

mentioned above, it becomes possible to join to an external end-connection child joint certainly, and to support external end-connection children, such as a solder ball, by having attached the external end-connection child joint in the ceramic circuit board which constitutes a package firmly. It makes it possible to be able to prevent certainly that a joint is damaged and to make reliable mounting by this, even if it is the case where the thermal stress resulting from the difference of the coefficient of thermal expansion of a mounting substrate and a semiconductor package acts on an external end-connection child's joint. Moreover, higher efficacy with the expandable use of the semiconductor device [become / possible / to attain enlargement of a semiconductor package / by this / it] using the ceramic circuit board is done so.

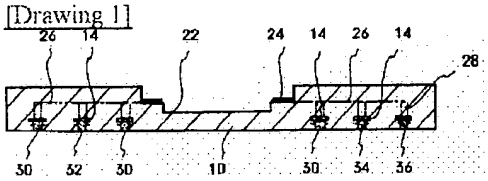
[Translation done.]

* NOTICES *

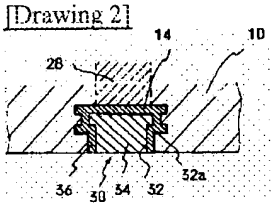
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

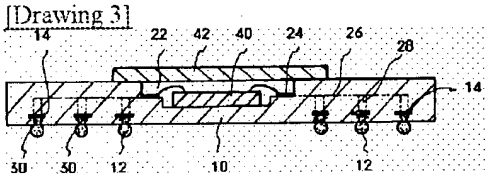
[Drawing 1]



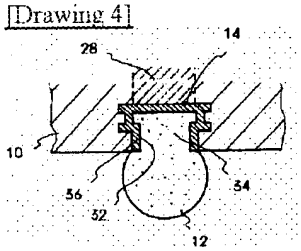
[Drawing 2]



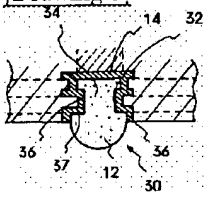
[Drawing 3]



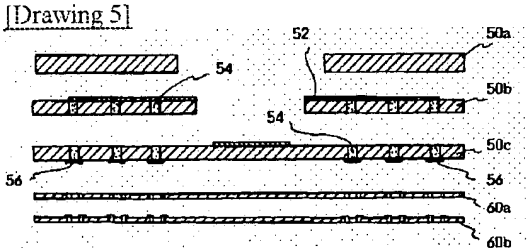
[Drawing 4]



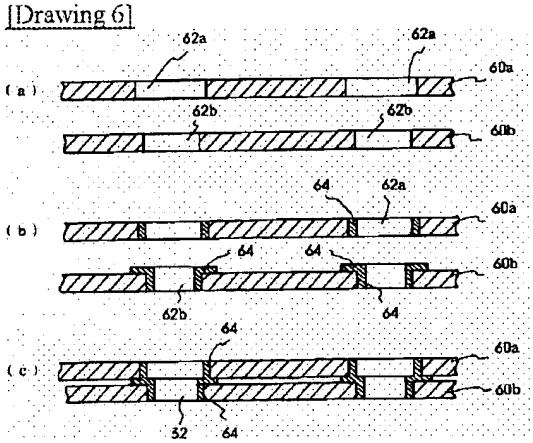
[Drawing 8]



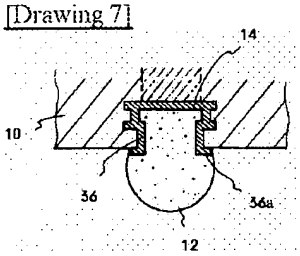
[Drawing 5]



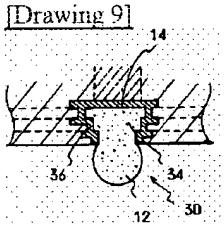
[Drawing 6]



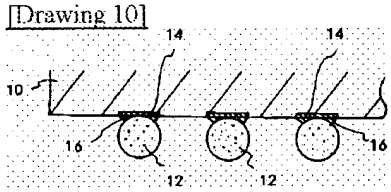
[Drawing 7]



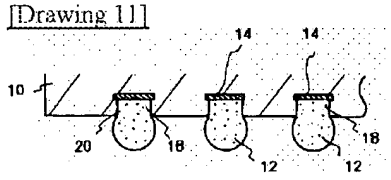
[Drawing 9]



[Drawing 10]



[Drawing 11]



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